CHAPTER 4

SIMULATION OF WATER MANAGEMENT SYSTEMS - PROCEDURE

This section discusses the procedure for using DRAINMOD to simulate the performance of a water management system. As an example, the design of a drainage system is considered. The required input data and a representative example of the program output are presented. Sources of input data and methods used to determine them are discussed in Chapter 5. Other examples of the use of DRAINMOD for evaluation and design are given in Chapter 6. The purpose of this chapter is to demonstrate the simulation procedure and examine the form of the required inputs and simulation output.

Example - A combination surface-subsurface drainage system

The soil chosen for this hypothetical example is a Wagram loamy sand located near Wilson, North Carolina. This soil type is usually well drained in nature and does not require artificial drainage. In this case, however, it is flat and is underlain by a very slowly permeably layer at a 1.8 m depth. Corn is to be grown on a continuous basis. The seedbed is to be prepared after about March 15 and corn planted by April 15; the harvest period is September 1 to October 15. The purpose of the drainage system is to provide trafficable conditions in the spring and ruing the fall harvest season, and to prevent excessive soil water conditions during the growing season. The simulation will tell us whether or not the given design will accomplish this purpose and how often it may be expected to fail.

Input Data

The input data for this example are given in Appendix A as card images arranged in the order that they are fed into the computer. The sources of these data and more details concerning the inputs are discussed below.

Soil Property Inputs

The relationships between drainage volume (or effective air volume above the water table) and water table depth were determined from large field cores as discussed by Skaggs, et al, (1978), and are plotted along with similar relationships for other soils in Figure 5-4. The relationship between maximum rate of upward water movement to supply ET requirements and depth of the water table below the root zone is given in Figure 2-15 for the Wagram soil. A summary of the other soil property inputs is given in Table 4-1.

Crop Input Data

The growing season for corn is approximately 120 days from April 15 to about August 15. The effective root zone depth is assumed to be dependent on time after planting and is arbitrarily taken as that given by the 60 percent curve from the data of Mengel and Barber, Figure 2-22. Soil water from a shallow surface layer will be removed (i.e., dried out to some lower limit water content) by evaporation even when the land is fallow. Therefore, an effective root zone depth of 3 cm was assumed for the period before and after the growing season. Other crop related input data are given in Table 4-1.

Drainage System Input Parameters

The drainage system consists of subsurface 102 mm (4 inch) drains spaced 45 m apart and 1 m deep. The surface drainage is only fair with some shallow depressions and an average surface storage depth of 12.5 mm. Convergence near the drain is accounted for by defining an equivalent depth

Table 4-1. Summary of soil property and crop related input data for Wagram loamy sand.

Parameter	Program Variable Name	Value
Depth to restricting layer	DEPTH	180 cm
Hydraulic conductivity	CONK	6 cm/hr (uniform)
Volumetric water content at lower limit (wilting point)	WP	0.05
Initial water table depth	IDTWT	0.0 cm
Minimum soil air volume required for tillage operations during:		
first work period (spring)	AMIN1	3.7 cm
second work period (harvest)	AMIN2	3.0 cm
Minimum rain to stop field operations:		
spring seedbed prep.	ROUTA1	1.2 cm
fall harvest	ROUTA2	0.5 cm
Minimum time after rain before can till:		
spring seedbed prep.	ROUTT1	1 day
fall harvest	ROUTT2	1 day
Working period for seedbed prep.:		
starting day	BWKDY1	74
ending day	EWKDY1	104
Working period for harvest:		
starting day	BWKDY2	240
ending day	EWKDY2	270
Working hours during spring:		
starting time	SWKHR1	0800
ending time	EWKHR1	2000
Working hours during harvest:		
starting time	SWKHR2	0800
ending time	EWKHR2	1800
Growing season - starting date	ISEWMS/ISEWDS	4/15
- ending date	ISDWME/ISEWDE	8/15
Depth on which SEW calculations are based	SEWX	30 cm

Parameters for Green-Ampt infiltration equation:	W.T. Depth	A(hr^{-1})	B($cm\ hr^{-1}$)
	0 cm	0	0
	50	3.0	1.0
	100	5.5	2.0
	150	8.7	3.0
	200	11.5	3.0
	500	25.0	3.0

from the drain to the impermeable layer according to the methods given by Hooghoudt (van Schilfgaarde, 1974). Methods given elsewhere Skaggs (1978b), were used to find an effective radius of a completely open drain tube from data presented by Bravo and Schwab (1975), and then to determine the equivalent depth using equations given by Moody (1966). Input parameters describing the drainage system are summarized in Table 4-2.

Table 4-2. Summary of drainage system input parameters.

Parameter	Program Variable Name	Value
Drain spacing	SDRAIN	45 m
Drain depth	DDRAIN	1 m
Equivalent depth to impermeable layer	HDRAIN	0.68 m
*Equivalent profile depth	DEPTH	1.68 m
Maximum depth of surface storage	STMAX	12.5 mm
Drain radius	**	57 mm
Effective drain radius	**	5.1 mm

* The equivalent profile depth is the sum of DDRAIN and HDRAIN and is used as input for the variable DEPTH, rather than the actual profile depth in Table 1.

**These variables are not inputs to DRAINMOD, but are used to calculate HDRAIN.

Climatological Input Data

Hourly precipitation and daily temperature data were obtained for Wilson, North Carolina, from HISARS. Inputs identifying the station and specifying the heat index for ET calculations were given on the EXECUTE JCL card. These inputs are given in Table 4-3.

Table 4-3. Inputs for calling climatological data from HISARS and ET calculations.

Parameter	Program Variable Name	Value
Station ID for precipitation	ID1	319476
Station ID for daily temperatures	ID2	319476
Latitude for temperature station	LATT	35° 47'
Heat index	HET	75.0
Year and month simulation starts	START	1952-01
Year and month simulation ends	END	1971-12

Other Input Data

Irrigation is not considered in the example given here. However, input data for irrigation must be specified; values are selected such that no irrigation water will be applied. An example of the irrigation inputs required for simulating the use of the above system for application of waste water is given in Appendix A.

Simulation Results

Sample results of the computer output for each simulation are shown in Tables 4-4 through 4-7. A listing of the input parameters and soil properties is given in Table 4-4. Daily summaries for the month of July 1959 are given in Table 4-5 and monthly summaries for 1959, a relatively wet year with a total of 1553 mm of rainfall, infiltration (INFIL), ET, cumulative drainage (DRAIN), runoff, total water leaving the field through the outlet drain (WLOSS) and the amount of irrigated water (DMTSI). In addition, soil water conditions at the end of the day are given by values for air volume in the wet zone (AIR VOL), total drained volume (TVOL), depth of dry zone (DDZ), depth of wet zone (WETZ), depth of the water table (DTWT), depth of water stored on the surface at the end of the day (STOR), depth of water in the outlet (DRNSTO). The SEW-30 value is also given for each day.

The monthly summaries (Table 4-6) give the totals of rainfall, infiltration, runoff, drainage, ET, dry days, working days, water lost from the field through the drainage outlet, SEW-30, total irrigation (MIR), number of irrigation events (MCN), depth of water pumped for subirrigation (PUMP), and the number of scheduled irrigation events postponed (MPT) for each month. Sample output results for a year (1961) with a smaller amount of rainfall are given in the output section of Appendix A. Also given in Appendix A is an example of simulation output when this water management system is used for disposal of waste water at a planned sprinkler irrigation rate of 2.5 cm/week.

The simulation was conducted for a 20-year period (1952-1971). The summary and ranking of the objective functions, which is printed out at the end of the simulation is given in Table 4-7. A probability analysis can then be conducted on the results in Table 4-7 and on similar results for other sets of design parameters to develop relationships between the objective functions and design parameters such as those given in Chapter 6 (e.g. Figures 6-11 and 6-12).

Figure 4-4. An example of computer output - listing of inputs - Wagram soil.

INPUT PARAMETER VALUES USED IN THIS SIMULATION

DEPTH TO DRAIN=100.0CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 68.0CM
DISTANCE BETWEEN DRAINS = 4500.0CM
MAXIMUM DEPTH OF SURFACE PONDING = 0.25CM
EFFECTIVE DEPTH IMPERMEABLE LAYER= 168.0CM
NUMBER OF DEPTH INCREMENTS= 33.
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET)= 1.50CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER=180.0CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER CAN MOVE TO DRAIN (FIG.2-12) = 1.25CM
FACTOR -C- IN KIRKHAM EQ. 2-17 = 21.70
MINIMUM AIR VOL REQUIRED FOR TRAFFICABILITY FOR FIRST WORK PERIOD(AMIN1)= 3.70CM
MINIUM DAILY RAINFALL TO STOP FIELD OPERATIONS FOR FIRST PERIOD (ROUTA1)= 1.25CM
MINIMUM TIME AFTER RAIN BEFORE CAN TILL FIRST PERIOD (ROUTT1) = 1.DAYS
MINIMUM AIR VOL REQUIRED FOR TRAFFICABILITY FOR SECOND WORK PERIOD (AMIN2)= 3.70CM
MINIUM DAILY RAINFALL TO STOP FIELD OPERATIONS FOR SECONDPERIOD (ROUTA2)= 1.25CM
MINIMUM TIME AFTER RAIN BEFORE CAN TILL SECOND PERIOD (ROUTT2)= 1.DAYS
JULIAN DATE TO BEGIN COUNTING WORK DAYS-FIRST PERIOD= 76
JULIAN DATE TO END COUNTING WORK DAYS- FIRST PERIOD=105
HOUR TO BEGIN WORK- FIRST PERIOD= 8
HOUR TO END WORK-FIRST PERIOD=20
JULIAN DATE TO BEGIN COUNTING WORK DAYS-SECOND PERIOD=368
JULIAN DATE TO END COUNTING WORK DAYS- SECOND PERIOD=368
HOUR TO BEGIN WORK- SECOND PERIOD= 8
HOUR TO END WORK- SECOND PERIOD=20
MAXIMUM ROOTING DEPTH= 30.0CM
CRITICAL DEPTH WET ZONE= 75.0CM
WILTING POINT= 0.05
INITIAL WATER TABLE DEPTH= 0.0
WIDTH OF DITCH BOTTOM= 60.0CM
SIDE SLOPES OF DITCH= 0.5:1
FIRST DAY OF SURFACE IRRIGATION= 1
INTERVAL BETWEEN SURFACE IRRIGATION DAYS=**
STARTING HOUR OF SURFACE IRRIGATION= 10
ENDING HOUR OF SURFACE IRRIGATION= 12
NO SURFACE IRRIGATION INTERVAL 1= 0 0
NO SURFACE IRRIGATION INTERVAL 2= 0 0
MINIMUM AIR REQUIRED TO HAVE SURFACE IRRIGATION= 3.50CM
AMOUNT OF RAIN TO POSTPONE SURFACE IRRIGATION= 1.00CM
SURFACE IRRIGATION FOR ONE HOUR= 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 CM

DEPTH	SATURATED HYDRAULIC CONDUCTIVITY
0.0 - 100.00	6.00000

DEPTHS OF WIERS FROM THE SURFACE

DATE	1/ 0.	2/ 0.	3/ 0.	4/ 0.	5/ 0.	6/ 0.	7/ 0.	8/ 0.	9/ 0.	10/ 0.	11/ 0.	12/ 0.
WIER DEPTH	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

INDICATER FOR DAILY SUMMERY= 0
INDET=99WHEN INDET.GT. 0 USE READ IN VALUES TO DETERMINE ET WHEN LIMITED BY SOIL CONDITIONS

Table 4-4 (Cont.) An example of computer output - listing of inputs - Wagram soil.

SOIL WATER CHARACTERISTICS AND RELATIONSHIP
BETWEEN WATER TABLE DEPTH AND DRAINED(VOID) VOLUME

VOLUME OF VOIDS	WATER TABLE DEPTH	HEAD	WATER CONTENT	VOLUME VOIDS ABOVE W.T.	UPFLUX
0.0	0.0	0.0	0.3020	0.0	3.0000
1.0000	43.3333	10.0000	0.2990	0.1000	2.0000
2.0000	54.2857	20.0000	0.2850	0.2500	1.0000
3.0000	61.1111	30.0000	0.2540	0.5000	0.5000
4.0000	66.6667	40.0000	0.2180	0.8000	0.3000
5.0000	71.6000	50.0000	0.1835	1.4000	0.1460
6.0000	75.6000	60.0000	0.1540	2.8000	0.0350
7.0000	79.6000	70.0000	0.1320	4.6000	0.0150
8.0000	83.1579	80.0000	0.1170	7.1000	0.0090
9.0000	86.6667	90.0000	0.1080	9.9500	0.0060
10.0000	90.1754	100.0000	0.1030	12.8000	0.0030
11.0000	93.6842	110.0000	0.0998	16.2400	0.0020
12.0000	97.1930	120.0000	0.0966	19.6800	0.0010
13.0000	100.5814	130.0000	0.0934	23.1200	0.0007
14.0000	103.4884	140.0000	0.0902	26.5599	0.0003
15.0000	106.3954	150.0000	0.0870	30.0000	0.0000
16.0000	109.3024	160.0000	0.0840	30.6111	0.0000
17.0000	112.2094	170.0000	0.0810	31.2222	0.0000
18.0000	115.1163	180.0000	0.0780	31.8333	0.0000
19.0000	118.0233	190.0000	0.0750	32.4444	0.0000
20.0000	120.9303	200.0000	0.0720	33.0555	0.0000
21.0000	123.8372	210.0000	0.0711	33.6666	0.0000
22.0000	126.7442	220.0000	0.0703	34.2777	0.0000
23.0000	129.6512	230.0000	0.0694	34.8888	0.0000
24.0000	132.5582	240.0000	0.0686	35.5000	0.0000
25.0000	135.4651	250.0000	0.0677	36.1111	0.0000
26.0000	138.3722	260.0000	0.0669	36.7222	0.0000
27.0000	141.2791	270.0000	0.0660	37.3333	0.0000
28.0000	144.1861	280.0000	0.0652	37.9444	0.0000
29.0000	147.0931	290.0000	0.0643	38.5555	0.0000
30.0000	150.0000	300.0000	0.0635	39.1666	0.0000
31.0000	166.3640	310.0000	0.0626	39.7777	0.0000
32.0000	182.7275	320.0000	0.0618	40.3888	0.0000
33.0000	199.0914	330.0000	0.0609	41.0000	0.0000
34.0000	215.4549	340.0000	0.0601	41.6111	0.0000
35.0000	231.8183	350.0000	0.0592	42.2222	0.0000
36.0000	248.1822	360.0000	0.0584	42.8333	0.0000
37.0000	264.5457	370.0000	0.0575	43.4444	0.0000
38.0000	280.9092	380.0000	0.0567	44.0555	0.0000
39.0000	297.2729	390.0000	0.0558	44.6666	0.0000
40.0000	313.6365	400.0000	0.0550	45.2777	0.0000
41.0000	330.0000	410.0000	0.0546	45.8888	0.0000
42.0000	346.3638	420.0000	0.0542	46.5000	0.0000
43.0000	362.7273	430.0000	0.0538	47.1111	0.0000
44.0000	379.0913	440.0000	0.0534	47.7222	0.0000
45.0000	395.4548	450.0000	0.0530	48.3333	0.0000
46.0000	411.8181	460.0000	0.0526	48.9444	0.0000
47.0000	428.1821	470.0000	0.0522	49.5555	0.0000
48.0000	444.5457	480.0000	0.0518	50.1666	0.0000
49.0000	460.9092	490.0000	0.0514	50.7777	0.0000

Table 4-4 (Cont.) An example of computer output - listing of inputs - Wagram soil.

GREEN AMPT INFILTRATION PARAMETERS

W.T.D.	A	B
0.0	0.0	0.0
50.000	3.000	1.000
100.000	5.500	2.000
150.000	8.700	3.000
200.000	11.500	3.000
500.000	25.000	3.000

VALUES READ IN

DAY	ROOT DEPTH
1	4.00
106	4.00
116	5.00
126	8.00
136	16.00
146	21.00
156	23.00
166	26.00
176	28.00
186	30.00
196	30.00
226	30.00
256	4.00
366	4.00

Table 4-5. An example of computer output for daily summaries - Wagram soil, July, 1959. All values given in cm.

1959 7

DAY	RAIN	INFIL	ET	DRAIN	AIR VOL	TVOL	DDZ	WETZ	DTWT	STOR	RUNOFF	WLOSS	YD	DRNSTO	SEW	DMTSI
1	2.90	2.90	0.52	0.0	12.75	16.88	16.40	99.82	116.22	0.0	0.00	0.00	0.0	0.00	0.0	0.0
2	0.38	0.38	0.61	0.0	12.79	17.11	17.15	99.95	117.10	0.0	0.00	0.0	0.0	0.00	0.0	0.0
3	0.13	0.13	0.41	0.0	12.82	17.39	18.14	100.07	118.21	0.0	0.0	0.00	0.0	0.00	0.0	0.0
4	0.0	0.0	0.42	0.0	12.89	17.81	19.53	100.27	119.80	0.0	0.0	0.0	0.0	0.00	0.0	0.0
5	0.0	0.0	0.46	0.0	12.96	18.27	21.05	100.48	121.53	0.0	0.0	0.0	0.0	0.00	0.0	0.0
6	1.19	1.19	0.53	0.0	13.00	17.60	18.26	100.59	118.85	0.0	0.00	0.00	0.0	0.0	0.0	0.0
7	0.0	0.0	0.53	0.0	13.07	18.13	20.08	100.79	120.88	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.47	0.0	13.14	18.61	21.68	100.99	122.68	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.71	0.71	0.31	0.0	13.18	18.21	19.96	101.10	121.06	0.0	0.00	0.0	0.0	0.00	0.0	0.0
10	2.24	2.24	0.34	0.0	13.21	16.31	12.30	101.20	113.50	0.0	0.00	0.00	0.0	0.0	0.0	0.0
11	3.53	3.53	0.28	0.0	13.06	13.06	0.0	100.77	100.77	0.0	0.00	0.00	0.0	0.0	0.0	0.0
12	2.26	2.26	0.30	0.01	11.11	11.11	0.0	94.06	94.06	0.0	0.0	0.01	0.0	0.0	0.0	0.0
13	8.00	7.72	0.20	0.12	3.70	3.70	0.0	65.00	65.00	0.0	0.28	0.39	0.0	0.0	0.0	0.0
14	1.70	1.70	0.22	0.19	2.41	2.41	0.0	57.20	57.20	0.0	0.00	0.19	0.0	0.0	0.0	0.0
15	3.68	2.95	0.20	0.34	0.00	0.00	0.0	0.00	0.00	0.11	0.63	0.97	0.0	0.0	7.50	0.0
16	5.03	0.45	0.42	0.55	0.53	0.53	0.0	30.91	30.91	0.22	4.47	5.03	0.0	0.0	15.70	0.0
17	0.53	0.75	0.42	0.40	0.59	0.59	0.0	33.14	33.14	0.0	0.00	0.40	0.0	0.0	1.32	0.0
18	0.15	0.15	0.48	0.32	1.24	1.24	0.0	47.41	47.41	0.0	0.00	0.32	0.0	0.0	0.0	0.0
19	0.53	0.53	0.47	0.27	1.45	1.45	0.0	50.37	50.37	0.0	0.00	0.27	0.0	0.0	0.0	0.0
20	1.14	1.14	0.41	0.28	1.00	1.00	0.0	43.35	43.35	0.0	0.0	0.28	0.0	0.0	0.0	0.0
21	0.51	0.51	0.37	0.30	1.16	1.16	0.0	46.01	46.01	0.0	0.00	0.30	0.0	0.0	0.0	0.0
22	0.0	0.0	0.57	0.26	1.99	1.99	0.0	54.19	54.19	0.0	0.0	0.26	0.0	0.0	0.0	0.0
23	0.0	0.0	0.56	0.22	2.77	2.77	0.0	59.80	59.80	0.0	0.0	0.22	0.0	0.0	0.0	0.0
24	0.0	0.0	0.56	0.19	3.53	3.53	0.0	64.03	64.03	0.0	0.0	0.19	0.0	0.0	0.0	0.0
25	2.62	2.62	0.56	0.17	1.64	1.64	0.0	51.74	51.74	0.0	0.0	0.17	0.0	0.0	0.0	0.0
26	3.20	2.46	0.46	0.36	0.00	0.00	0.0	0.00	0.00	0.08	0.65	1.01	0.0	0.0	9.26	0.0
27	4.95	0.20	0.47	0.47	0.74	0.74	0.0	38.02	38.02	0.21	4.63	5.10	0.0	0.0	8.71	0.0
28	0.10	0.31	0.43	0.33	1.19	1.19	0.0	46.49	46.49	0.0	0.00	0.33	0.0	0.0	0.0	0.0
29	0.10	0.10	0.46	0.26	1.81	1.81	0.0	52.91	52.91	0.0	0.00	0.26	0.0	0.0	0.0	0.0
30	0.74	0.74	0.58	0.23	1.88	1.88	0.0	53.43	53.43	0.0	0.00	0.23	0.0	0.0	0.0	0.0
31	0.05	0.05	0.48	0.23	2.54	2.54	0.0	58.15	58.15	0.0	0.00	0.23	0.0	0.0	0.0	0.0
	Daily Rainfall	Daily Infiltration	Daily ET	Daily Drainage	Air Volume in (or Drained Volume from) Wet Zone	Total Air Volume in Profile	Depth of Dry Zone	Depth of Wet Zone	Depth of Water Table	Depth of Water Stored on the Surface	Daily Runoff	Daily Water Leaving Outlet	Depth of Water in Outlet Ditch	Water Stored in Outlet-Equivalent Depth Over the Field	Daily SEW_{30}-cm Days	Amount of Water Irrigated

Table 4-6. An example of computer output for monthly summaries - Wagram soil, 1959.

MONTHLY VOLUMES IN CENTIMETERS FOR YEAR 1959

MONTH	RAINFALL	INFILTRATION	RUNOFF	DRAINAGE	ET	DRY DAYS	WRK DAYS	WATER LOSS	SEW	MIR	MCN	PUMP	MPT
1	5.97	5.97	0.00	5.50	1.19	0.0	0.0	5.59	0.0	0.0	1	0.0	0
2	10.59	9.24	1.35	6.71	1.45	0.0	0.0	8.06	0.0	0.0	0	0.0	0
3	12.17	10.69	1.48	7.39	2.48	0.0	5.46	8.87	0.0	0.0	0	0.0	0
4	18.77	13.53	5.24	8.94	6.53	0.0	1.58	14.17	40.81	0.0	0	0.0	0
5	4.93	4.93	0.00	1.81	11.02	0.0	0.0	1.82	0.0	0.0	0	0.0	0
6	6.93	6.93	0.00	0.16	13.72	0.0	0.0	0.17	0.0	0.0	0	0.0	0
7	46.38	35.72	10.66	5.51	13.49	0.0	0.0	16.17	42.50	0.0	0	0.0	0
8	12.88	12.88	0.00	3.42	11.41	1.00	0.0	3.42	0.0	0.0	0	0.0	0
9	6.53	6.53	0.00	2.72	8.97	0.0	0.0	2.72	0.0	0.0	0	0.0	0
10	17.12	17.12	0.00	4.56	5.55	0.0	0.0	4.56	0.0	0.0	0	0.0	0
11	6.10	6.10	0.00	5.40	2.61	0.0	0.0	5.40	0.0	0.0	0	0.0	0
12	6.93	6.93	0.00	5.25	1.29	0.0	0.0	5.25	0.0	0.0	1	0.0	0
TOTALS	155.30	136.57	18.73	57.35	79.72	1.00	7.04	76.10	83.31	0.0		0.0	

Table 4-7. Example of computer output of yearly summaries and ranking of objective functions - work days, SEW_{30} dry days and yearly irrigation for drainage.

RANK	WORK DAYS	YEAR	SEW	YEAR	DRY DAYS	YEAR	IRRIGATION	YEAR
1	29.65	1966	97.51	1953	50.00	1954	0.0	1951
2	28.67	1955	83.31	1959	38.00	1952	0.0	1952
3	28.00	1967	63.83	1967	32.00	1955	0.0	1953
4	25.33	1951	62.01	1965	26.00	1957	0.0	1954
5	23.10	1968	37.39	1960	24.00	1970	0.0	1955
6	18.50	1953	30.60	1958	22.00	1956	0.0	1956
7	13.32	1954	0.0	1951	21.00	1964	0.0	1957
8	13.28	1969	0.0	1952	15.00	1951	0.0	1958
9	13.24	1963	0.0	1954	10.00	1953	0.0	1959
10	10.99	1952	0.0	1955	10.00	1960	0.0	1960
11	10.92	1970	0.0	1956	8.00	1962	0.0	1961
12	10.68	1965	0.0	1957	6.00	1958	0.0	1962
13	10.58	1957	0.0	1961	4.00	1963	0.0	1963
14	8.61	1956	0.0	1962	4.00	1969	0.0	1964
15	7.04	1959	0.0	1963	2.00	1959	0.0	1965
16	5.50	1961	0.0	1964	2.00	1961	0.0	1966
17	4.94	1964	0.0	1966	2.00	1965	0.0	1967
18	4.23	1960	0.0	1968	2.00	1967	0.0	1968
19	1.06	1962	0.0	1969	0.0	1966	0.0	1969
20	0.0	1958	0.0	1970	0.0	1968	0.0	1970
AVERAGE	13.38		18.73		13.90		0.0	